REMARKS

The above Amendments and these Remarks are in reply to the Office Action mailed April 4, 2005.

The specification has been amended to provide updated references to the cited patent documents.

Currently, claims 1-46 are pending. Claims 10, 16, 18, 25, 26 and 41 are amended. No new matter is entered.

Claims 10 and 16 have been amended to correct a typographical error. The dependency of claims 18 and 25 has been amended. Claims 26 and 41 have been amended to improve readability.

Applicants acknowledge that claims 16, 17, 19-32, 34 and 46 are allowed, and that claims 4-10, 15, 18 and 40 are considered to include allowable subject matter.

Claims 1-3 and 11-14 have been rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 6,656,551 to Mokhlesi et al. Separately, claims 33, 35-39, and 41-45 have also been rejected under 35 U.S.C. §102(e) as being anticipated by Mokhlesi et al. Applicants respectfully traverse the rejections.

Mokhlesi et al. provides a system for programming non-volatile memory cells in which a source de-biasing is provided by a current sink (current limiter 403, Fig. 4A) which limits the drain-to-source programming current of a cell. The current sink can be adjusted to turn off the source de-biasing toward the end of each sector's programming when a small fraction of cells remain to be programmed (col. 6, lines 31-33 and 48-52). In particular, the current limit can be raised for the hard-to-program cells after a specified portion of the cells remain unprogrammed and/or after a certain number of voltage pulses have been applied to the cells (col. 11, line 66-col. 12, line 4). Moreover, the current limit can be raised progressively to different specified levels $I_{prog,1}$, $I_{prog,2}$,... (col. 12, lines 8-10). For the hard-to-program cells, a number of programming pulses at a maximum control gate voltage can be applied with the raised current limit (col. 12, lines 22-30).

Furthermore, the approach of Mokhlesi et al. can be extended to a coarse-fine programming technique, as illustrated in Fig. 5. In this approach, if storage units or cells verify to a coarse

reference value, the process switches to a fine mode (col. 13, lines 26-28). In particular, in the coarse mode, a coarse programming pulse is applied to a cell by placing a voltage across the source and drain of the cell while the current is limited to a first level (col. 13, lines 29-33; Fig. 5, step 503). A coarse verify step is then performed to determine if the cell has reached a target criteria (step 505). If the cell is not verified to have met the criteria, the programming voltage is increased and another pulse is applied to the cell (step 509), as long as a maximum programming voltage has not been reached (step 507). If the cell still has not been verified to have met the coarse verify criteria after the maximum programming voltage has been applied, the value of the current used by the current sink is incremented while the maximum programming voltage is repeatedly applied in a number of cycles until either the cell is verified to have met the coarse verify criteria (step 515) or the current used by the current sink has been incremented to a maximum value (step 511).

If the cell still has not been verified to have met the coarse verify criteria after the maximum programming voltage has been applied, and after the current used by the current sink has been incremented to a maximum value (step 511), a number N_C of coarse pulses of the maximum programming voltage at the maximum current used by the current sink is applied to the cell.

A fine verify process is entered from any of the decision blocks 505, 515, 519 and 523 in Fig. 5. In this process, the control gate voltage is stepped back, and steps 531-551 of the fine verify process are the same as the corresponding steps in the coarse programming phase (col. 13, line 65 to col. 14, line 3), except that a cell is locked out from further programming once it meets a fine verify criteria. A failure is declared if a cell does not meet the fine verify criteria after a maximum number N_{Fmax} of fine pulses of the maximum programming voltage at the maximum current used by the current sink have been applied to the cell.

Accordingly, Mokhlesi et al. provide no disclosure or suggestion of adapting the current used by the current sink according to whether the cell is in a coarse or fine programming mode. Instead, for both the coarse and fine programming modes, the current is limited to the same first level (col. 13, lines 29-33) throughout the time when the programming voltage is being incrementally increased in steps 509 and 535. Moreover, the current used by the current sink is incremented in the same way

at blocks 513 and 539 for both the coarse and fine programming modes since Mokhlesi et al. teaches that these corresponding steps are the same (col. 13, line 67 to col. 14, line 1).

In contrast, Applicants' claim 1 sets forth an apparatus for programming where a coarse current sink is provided to a control terminal of a non-volatile storage element if the non-volatile storage element is in a coarse programming mode, and a fine current sink is provided to the control terminal if the non-volatile storage element is in a fine programming mode. Accordingly, the level of the current sink used is adapted according to whether the non-volatile storage element is in a coarse or fine programming mode. This is an important distinction over Mokhlesi et al. because the threshold voltage Vt changes for each program pulse based on the level of the current sink. See Applicants' specification at Fig. 16 and page 32, lines 1 and 2, for example, where different programming curves 500, 502, 504, 506 and 508 represent the change in Vt for different current sinks. Claim 1 is therefore clearly patentable over Mokhlesi et al.

The dependent claims of claim 1 are therefore also clearly patentable over Mokhlesi et al. For example, regarding claim 2, the coarse current sink can be greater than the fine current sink. The Examiner asserts that columns 10-14 of Mokhlesi et al. disclose this feature but it is clear from the above discussion that Mokhlesi et al. provides no disclosure or suggestion of adapting the current used by the current sink according to whether the cell is in a coarse or fine programming mode. Claim 2 is therefore clearly patentable over Mokhlesi et al.

Furthermore, independent claims 33, 35 and 41 are clearly patentable over Mokhlesi et al. for the reasons discussed above. Each of these claims sets forth an apparatus or method where the current used by a current sink for a cell is adapted based on whether the cell is in a coarse or fine programming mode.

Based on the above amendments and these remarks, reconsideration of the rejected claims is respectfully requested.

The Examiner's prompt attention to this matter is greatly appreciated. Should further questions remain, the Examiner is invited to contact the undersigned attorney by telephone.

The Commissioner is authorized to charge any underpayment or credit any overpayment to Deposit Account No. 501826 for any matter in connection with this response, including any fee for extension of time, which may be required.

Respectfully submitted,

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